SCIENCE:

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

PUBLISHED BY

N. D. C. HODGES,

47 LAFAYETTE PLACE, NEW YORK.

SUBSCRIPTIONS.—United States and Canada..............$3.50 a year.

Great Britain and Europe.................4.50 a year.

Communications will be welcomed from any quarter. Abstracts of scientific papers are solicited, and one hundred copies of the issue containing such will be mailed the author on request in advance. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

COTTON-SEED MEAL IN THE DAIRY RATION.

IN bulletin No. 14 of the Texas Experiment Station is reported a series of experiments made to determine the influence of cotton-seed meal in the dairy ration on the creaming of milk, both by the common or gravity method and the centrifugal method.

In these experiments, cows were tested in lots containing several cows each, the cows in the contrasted lots being in as uniform a condition with respect to milk-flow, time from calving, etc., as it was possible to arrange them. The feed for each pair of contrasted lots was the same, except that one lot received equal parts of corn-meal and bran as bye food, while the other lot had cotton-seed meal and bran in equal parts.

In the case of two lots of five cows each that were far advanced in milk (100 to 124 days on the average) it was found that where the cream was raised by gravity at the ordinary summer temperature, the milk being set at about 70° in Fairlamb cans and skimmed when sour (in twelve to twenty-four hours), an average of 18.4 pounds of butter was lost in the skim-milk of the cows fed on cotton-seed meal for every hundred pounds present in the milk set, as againt 30.9 pounds lost when no cotton-seed or cotton-seed meal was fed.

In the case of two lots of four cows each, less advanced in milk (88 to 93 days) the loss of butter-fat in the skim milk on the cotton-seed meal ration was 22.7 pounds out of every hundred pounds actually present in the original milk, against 31.8 pounds lost when no cotton-seed meal was used.

In the case of two lots of three cows each that averaged but fifty days from calving at the beginning of the test, the loss was 11.3 pounds on cotton-seed meal ration, against 14.9 pounds when no cotton-seed was fed.

The average loss on cotton-seed meal for ordinary setting was therefore 17.5 pounds out of every hundred pounds present in the original milk, against 25.8 pounds lost when no cotton-seed meal was fed.

Where the milk of five cows, a hundred and fifty-two days from calving, was set at a temperature of 45°, and kept at this temperature with ice for twenty-four hours and then skimmed, the loss was 37.6 pounds out of every hundred pounds in the original milk, the cows having no cotton-seed meal; while five cows a hundred and thirty-two days from calving and having cotton-seed meal, lost but 22.9 pounds out of every hundred. When the milk was kept only twelve hours before skimming, the loss without cotton-seed meal was 49.1 pounds, against 31.7 pounds lost with cotton-seed meal, showing a decided advantage in the longer setting.

When the cream was extracted by the centrifugal method as soon as milked, that from four cows, two hundred and ten days from calving, showed a loss of but 1.8 pounds without cotton-seed, and that from four cows, two hundred and eleven days from calving, but 2.3 pounds with cotton-seed meal. That from four cows, sixty-two days from calving, and having no cotton-seed, lost 3.27 pounds, and that from four cows, fifty-eight days from calving, and having cotton seed, lost 3.3 pounds out of every hundred actually present in the whole milk.

These results show that in the case of centrifugal creaming, a very much larger per cent of the butter-fat present in the milk is obtained, and that without regard to the character of the feed used, whereas in ordinary gravity creaming the character of the food may have a very marked influence upon the quantity of butter obtained from the milk.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Throwing-Sticks.

IN the report of the National Museum for 1884 I published a short paper on the "throwing-sticks" of the Eskimo in the Department of Ethnology. The object of this article was to show how the methods and problems of natural history are applicable to the products and apparatus of human industry. Here we had a homogeneous people in blood and language, occupying a zoological area which we call hyperborean, and stretching out to cover Labrador, Greenland, all Arctic Canada, and the shores of Alaska from the Mackenzie district all round to Mt. St. Elias. It was with genuine pleasure that I afterward received from Dr. Seler, Mr. Murdoch, Dr. Stolpe, Dr. Uhle, Mr. Bahnson, Mrs. Nuttall, and Dr. Mortillet their own later contributions upon the same ingenious implement, with the acknowledgements that their publication was stimulated by the Eskimo paper. (Altmexikanische Wurfbretter, von Dr. Ed. Seler, Internationales Archiv für Ethnographie, Bd. iii., 1890; The History of the "Throwing-stick" which drifted from Alaska to Greenland, by John Murdoch, Am. Anthropologist, July, 1890; Ueber Altmexikanische und südamerikanische Wurfbretter, von Dr. Hjalmar Stolpe, in Stockholm, Internat. Archiv f. Ethnog., Bd. iii., 1890; Ueber die Wurfholzer der Indianer Amerikas, von Dr. Max Uhle, Mittheil. der Anthrop. Gesellsch., in Wien, Bd. xvii., n.f. vii., 1887; Ueber südamerikanische Wurfholzer im Kopenhagener Museum, von Kristian Bahnson, Internat. Archiv f. Ethnog., ii., 1889; Mrs. Zelia Nuttall, in a paper read before the Woman's Anthropological Society in Washington, entitled The Atlatl or Spear-Thrower of the Ancient Mexicans, Arch. and Ethnol. Papers of the Peabody Museum, i., No. 3; Les Propulseurs a crochet Modernes et Prehistoriques, Part A., drien de Mortillet, Rev. Mensuelle de l'Ecole d'Anthropologie de Paris, i., 15 Aout, 1891.)

In plate xvii. of my paper two very interesting old specimens are described from the Tlingit or Koloschanaua about Sitka. One of these is figured in Ensign Niblack's monograph (Smithsonian Report, Part II., 1888, plate xxvii, fig. 157). These specimens are very old, are covered with totemic devices, and represent a decayed art passed into its mythic stage. I do not now know of any similar device for throwing spears or harpoons until we get to Mexico, where, as is well shown in the works above quoted, the altatl was one of the commonest weapons. Imagine my great pleasure, therefore, on receiving from Lake Patzcuaro, in Mexico, a modern altatl, well-worn and old looking, accompanied with a gig for killing ducks. The apparatus was bought from the hunter by Capt. John G. Bourke, U.S.A., and may now be seen in the National Museum. The thrower is two feet three inches long, and has two finger-holes projecting, one from the right and one from the left side. In my paper on the Eskimo stick no case of two

finger-holes occurs, and the only example in which it projects from the side at all is from Point Barrow. Since the publication, however, another specimen comes from Cerles inlet, and this is quite puzzling. In Dr. Stolpe's paper you have my Patzcuaro specimen exactly, only mine has no ornament and is a practical every-day implement for killing ducks. The spear-shaft is ten feet long, of slender cane, and has a hole at the after end for the hook of the throwing stick. The gig consists of three iron barbs, for all the world like the Eskimo trident for water-fowl. The problem now is to connect Alaska with Patzcuaro.

O. T. MASON.

Washington, D.C., Oct. 26.

Molecular Motion in the Development of Water Waves.

WHEN waves are developed on the surface of water, whether by something thrown into or moving through the water, or by the friction of the wind blowing along the surface, the water constituting the wave rises up and sinks down, but does not move along the surface. When the friction of the wind is the cause of wave production, or when the waves are produced by any other force exerting a pull or a push in the water, there is some horizontal movement or current; but this current is not wave-motion proper, and is entirely distinct from it. The undulations in a slack rope, vibrated at one end, are true wave-motion, analogous to that which occurs on the surface of water.

If we suppose the water to consist of molecules, each having capacity for its own proper motion, and subject to the force exerted by the earth's attraction and by the pressure of other molecules above it, but free to move with comparatively small friction, the formation of waves becomes very simple. Water under the pressure when the formation of waves is possible, is incompressible, and when a solid body is thrown into or moved through the water so rapidly that the displaced particles cannot get out of the way laterally, some of them are forced up, under the well-known law that motion is in the direction of least resistance. If the body is placed in or drawn through the water slowly enough for the displaced particles to push their way horizontally, none of them are thrown up, and the initial wave is not formed. But time is required for this movement, and when the body is thrown into the water, or moved through it rapidly, the displaced particles are forced to rise up against the force of gravitation, the quantity forced up — that is, the size of the initial wave — being determined by the volume of the body and the rapidity of its movement through the water. If the force is impulsive and not constantly acting, the second wave is less than the first, and they go on diminishing until the force is expended in horizontal motion, and there is an elevation of the surface commensurate with the volume of the immersed body, — the same result precisely that would have been reached without wave-formation if the body had been immersed slowly enough.

When wind first impinges against the surface of still water, the friction pulls up a little of the water in the form of a minute initial wave, but the force being constantly acting, the wave continues to increase in size until the maximum possible from the given friction is reached.

The force of cohesion between the molecules of water is less than the pull of gravitation upon them, for if this were not the case, water would stand up like a solid mass, as ice does, instead of spreading out and flowing, in obedience to the force of gravitation, and continuing to flow until it reaches some substance in which the force of cohesion is sufficient to counteract the pull of gravitation on its molecules, or until the increased cohesion from congelation accomplishes the same result.

While the force of cohesion between the molecules of water is not sufficient to prevent them from moving in obedience to the force of gravitation, it is still considerable, and very great as compared with the force of cohesion between the molecules of air and other gases; and when a portion of the water is forced up against the force of gravitation, the substance continues in mass, and must so continue until subjected to a force sufficient to overcome both gravitation and cohesion.

When the mass lifted up in the formation of the initial wave falls back (as it must do under the constantly acting force of gravitation), with a velocity too great to be expended in horizontal motion, the molecules receiving this impact must rise up as those did which constituted the initial wave, and so on, each wave being the progenitor of that wave which follows it. If the force is impulsive, as when a body is thrown into the water, each wave is the sole progenitor of the wave following; if the force is constantly acting, like the friction of the wind, each wave in producing another is supplemented by the constantly acting force which caused the initial wave.

When the uplifted water falls back on something not so free to move as the molecules of water, — as, for instance, when the water becomes so shallow that the fall is against the bottom, or so thick with grass and water-plants as to impede the free movement of the water, — the wave-formation at once begins to diminish and soon ceases entirely. In short, the waves on the surface of the water are the result of the impact of the lifted-up mass falling back on the free to-move molecules constituting the whole mass with a velocity so great that the force cannot be transmitted horizontally.

In observing the phenomenon on a lake a few miles wide, it is interesting to note that, even in a high wind, the surface of the water near the windward shore is only a little agitated by small ripples; farther out it becomes rougher, and on the lee shore the waves have reached the highest point possible for the extent of surface and force of the wind. The pressure of the wind on the surface of an inland lake is constantly variable, even over comparatively small areas, as every one has observed who has navigated a sail-boat; and as the friction, which is the wave producing force, varies with the pressure, the waves vary in both length and height.

When the wind is high the crests of the highest waves become unable to withstand the impact of the force, and are broken into fragments or spray, forming what we call "white-caps." This phenomenon does not depend entirely on the violence of the wind, nor on the height and volume of the waves, but it depends on the relation between these two. If the waves are very large and oval (and this depends on the nature and action of the force producing them), only the most violent wind can cause white-caps, while if the waves are small but narrow and sharp, a comparatively light wind will develop them. In a portion of the water broken up in the formation of white caps, not unfrequently the force of cohesion is so far counteracted that the water is carried off in the form of spray; the residue of the white-cap not carried off as spray, instead of sinking down with the main body of the wave as in other cases, flows down the farther side of it. Hence the formation of white-caps tends to diminish rather than to increase the size of the waves.

It sometimes happens that the impact of the wind against the water elevated above the surface becomes so violent that it is all blown away as spray, and no waves are formed at all. In January, 1884, I think it was, this phenomenon occurred on Lake Eustis, in Florida. We took passage on the "Mayflower," a little side-wheel steamer of from thirty to forty tons burden, very narrow and long, and low decked, to cross the lake from east to west, the distance being about seven miles. It was blowing a breeze from the west, which caused waves probably a foot high, and sufficient to cause the little steamer to rock perceptibly. A very black cloud came up from the west, meeting us, and between one and two o'clock in the afternoon, when we were about one-fourth of the way across, a storm of wind and rain burst upon us with intense fury. Putting on my overcoat hastily, I at once made my way with difficulty through the wind and rain to the pilot-house, a little coop perched on the front end of the deck, to see that the captain, who was steering, did not lose his presence of mind, and to urge him to hold the head of the boat to the wind, from whatever direction it might come. Finding him cool and self-possessed, I returned to the cabin, another little coop amidships, and found the passengers, eight or ten in number, in great terror. Acting on a suggestion of the captain, I got out the life-preservers, and in less time than it takes me now to write this sentence, each passenger had on one, ready for the plunge which we all knew would come in a few seconds if the wind struck the